CHAPTER 2

Literature Review

This chapter reviews and discusses literature relevant to our study. It is divided into six sections: Section 1 introduces the theory of knowledge sharing and models of knowledge transition. Section 2 introduces the instructional strategies of online collaborative discussion. Sections 3 and 4 discuss strategies used to enhance knowledge sharing activities: problem solving and peer-assessment and existing related studies. In Section 5, we discuss the limitations and current status in implementing online teacher communities. In Section 6, we discuss the current status and limitations of online project-based learning activities. Finally, we discuss research methods for analyzing online discussions in Section 7 and describe the methods used in this study.

2.1 Knowledge Sharing

Knowledge sharing is the process of knowledge transition among community members. Many studies have proposed models of knowledge transition (Nonaksa & Takeuchi, 1995; Gilbert & Gordey-Hayes, 1996; Davenport & Prusak, 1998; Hendriks 1999). Nonaka & Takeuchi (1995) focused on the correlation between knowledge transition and knowledge creation and discussed a model for transition, stating that the creation of knowledge is made possible by knowledge-transition between ontology and knowledge aspect. The former includes the individual, group, organization, and inter-organization, while the latter includes the sub-aspects of tacit and explicit knowledge; knowledge creation is achieved through interaction between these two types of knowledge. The model includes the following four phases: (1) Socialization, i.e. the transition from one tacit knowledge to another. Socialization refers to an individual sharing experiences and the transition of mental models, not reliant on language or words. This includes apprenticeship, observation, and imitation, and is more focused on face-to-face observation. (2) Externalization, i.e. the transition from tacit knowledge to explicit knowledge; knowledge is basically shared through concepts, hypotheses, or models. For example, a person's beliefs, know-how or opinions are expressed via language, written materials, or images. (3) Internalization, i.e. the transition from explicit knowledge to tacit knowledge, in which explicit languages, documents, and images are externalized, so they can be absorbed by an individual and turned into his or her tacit knowledge. For example, a person reads a technical manual and understands a certain skill. (4) Combination, i.e. the transition from explicit knowledge to explicit knowledge. Through methods such as storage, adding, arranging, combining, classifying, and recombining, existing explicit knowledge becomes systematic. For example, computer systems or knowledge bases allow members to collect and combine existing explicit knowledge. With these four aspects, knowledge transition allows socialization, externalization, internalization, and combination, which constantly circulate and accumulate knowledge. Ontology aspect extends from a person to the group, organization, and inter-organization, and the process of knowledge transition forms a dynamic system.

Hendriks (1999) proposed that basic knowledge sharing includes two bodies: knowledge owners and knowledge demanders. The former need to be willing to "externalize" their knowledge via lectures, writing, or other methods, and the latter need to acquire and "internalize" the knowledge through listening or reading. While learning knowledge, knowledge-demanders must also reconstruct knowledge; knowledge sharing refers to the process of knowledge internalization and externalization.

Gilbert & Gordey-Hayes (1996) emphasized that an organization must first have an interaction mechanism before knowledge-transition can take place. Davenport & Prusak (1998) also pointed out the importance of using knowledge sharing strategies to promote knowledge sharing.

Nonaksa & Takeuchi (1995) and Hendriks (1999) discussed how knowledge is transferred; while they had their own features and focuses, they all emphasized the importance of the two factors: knowledge "internalization" and knowledge “externalization.” Davenport & Prusak (1998) and Gilbert & Gordey-Hayes (1996) all emphasized designing mechanisms or strategies to promote knowledge exchange or transition.

The development of knowledge management systems and a “knowledge base” to assist knowledge management/sharing has become pervasive (Spector, 2002; Plass, 2002; Rafaeli, et al., 2004), and appropriate use of technology promotes knowledge interactions. However, some studies point out that many organizations believe that technology will promote knowledge sharing (Dixon, 2000; Pfeffer & Sutton, 1999), but, people are not necessarily willing to share their knowledge. Therefore, many studies on knowledge sharing have discussed motives, rewards, and trust among an organization’s members (Bock et al., 2005; Kankanhalli et al., 2005; Wasko & Faraj, 2005; Hsu, et al., 2007) and the mechanism that uses technology to promote knowledge sharing (Li, Montazemi & Yuan, 2006; Ras et al., 2005; Rafaeli et al., 2004; Soller, 2004; Roda et al., 2003). Moreover, knowledge sharing behavior is correlated with an organization’s features (Yang, 2007; Yang & Chen, 2007; Bock et al., 2005). Different organizations have different knowledge sharing contexts, so it is most appropriate to design knowledge sharing activities with suitable technology based on the organization’s characteristics.

The above literature review shows that to promote knowledge sharing in online teacher/learner communities, we should consider their organizational culture and design strategies and online discussion mechanisms that promote inter-member knowledge internalization/externalization. The strategy must also incorporate a suitable online knowledge sharing environment to achieve the best results. This is exactly what we are exploring in this study. In order to develop suitable knowledge sharing activities, we review strategies that promote community collaborative learning and integrate these strategies into activities. In the following sections, we review literature regarding “problem solving” and “peer assessment” – the two strategies frequently applied in the educational technology.

2.2 Instructional Strategies of Online Collaborative Discussion

Ever since the Internet was introduced, education paradigms and e-Learning tools have developed rapidly for the past twenty years. With the arrival of Web 2.0 which allows users to actively participate and interact with each other (Musser & O’Reilly, 2006), the applications of the Internet are also changing, which also affects the development of educational technologies and makes e-Learning more interactive and diverse. The interactive features of the Internet that focus on users are able to help learners achieve knowledge construction through knowledge sharing.

The theory and paradigm of knowledge construction have been widely discussed for the past decades (Malinowski, 1967; Mary, & Cook, 1991; von

Glaswesfeld, 1993; Allchin, 1999). Constructionists focus on the user-centered process of knowledge construction (von Glaswesfeld, 1993; Allchin, 1999), in which learning is achieved through knowledge sharing under social interactions (Lochhead & Yager, 1996; Leach & Scott, 2000), and knowledge is gradually constructed through the cognitive conflicts and consensus reached through social interactions (Driver, et. al, 1994).

The Internet's high interactivity helps remove the temporal and spatial limitations in education, allows for more efficient knowledge interactions, and promotes teaching through online collaborative learning (Chang & Chen, 1997). There are currently many studies on online collaborative learning as well as interactions in online discussions (Hewitt, 2005; Fahy, Crawford, & Ally, 2001; Sudweeks & Simoff, 1999; Gunawardena, Lowe & Anderson, 1997; Newman, Webb & Cochrane, 1995; Levin, Kim, & Riel, 1990). Many studies also suggest important correlations between the design of online discussion mechanisms and the depth of discussions (Patricia & Dabbagh, 2005; Hewitt, 2003; Vonderwell, 2003; Swan, at el., 2000; Vrasidas & McIsaac, 1999). Therefore, an important topic today is how to design a good teaching activity involving online discussions. Currently, instructional designers can apply common interactive instructional strategies on the Internet in order to design online discussion teaching activities. The followings are interactive instructional strategies that are more commonly seen:

(1) Problem solving (Gagne, 1980; Mayer, 1985; Hatch, 1988; Sternberg, 1996; Gagne & Briggs, 1979; Henna, Potter & Hagaman, 1995) : Teachers or students ask questions and achieve knowledge exchange or construction by discussing on the same topic and develop problem solving skills.

(2) Peer assessment (Topping, 1998; Falchikov & Goldfinch, 2000 Cizek, 1997; Shepard, 2000 Lin, Liu, & Yuan, 2001; Sung, Chang, Chiou & Hou, 2005): Students look at each others' work and comment on/assess on them, and this allows them to think critically, develop cognitive skills, and construct knowledge.

(3) Peer tutoring (Annis, 1982; Cohen, Kulik, & Kulik, 1982; Greenwood, Carta, & Hall, 1988; Miller, 1995; Fantuzzo, King & Heller, 1992): Students guide and tutor each other in order to reorganize and express their thoughts, allowing them to develop expression skills and achieve knowledge construction.

(4) Role playing (Kirs, 1994; Bell, 2001): Students play the roles in certain situations, allowing them to think based on the situations, interact, and achieve knowledge construction.

The above-mentioned interactive strategies all have their features and can serve as the basis for designing online discussion teaching activities. Since problem solving and peer assessment have been widely used on the studies on online teaching for many years, we will explore these two strategies in this study first in order to analyze the behavioral process when they are applied in online knowledge-sharing discussions.

2.3 Problem Solving

Problem solving is an instructional strategy frequently used in collaborative learning (Gagne & Briggs, 1979); there have been many studies on instructional strategies that use online problem solving methods. Different scholars define "problem solving" in different ways (Gagne, 1980; Mayer, 1985; Hatch, 1988; Sternberg, 1996); Gagne (1980) treats problem solving as the process of recombining previous knowledge and solving a new problem. Mayer (1985) believes that "problem solving" is the process of transforming an initial status to a targeted status, and proposed that problem solving is a cognitive process, the behavior of an individual seeking a solution, and a process of using previous experience. Hatch (1988) defines "problem solving" as the process of finding a suitable solution to a question. Sternberg (1996) believes "problem solving" is a process of removing obstacles when finding solutions.

The above scholars' opinions indicate that "problem solving" focuses on using past experience and knowledge, thinking deeply, and using cognitive skills to solve new problems. This kind of process not only helps solve problems but can also encourage learners to interact/discuss with peers and develop their cognitive skills when applied in group learning settings. This is why it has long been used as a teaching strategy (Gagne & Briggs, 1979).

Many studies propose procedures and models of problem solving. Isaksen & Parnes (1985) describe six elements of problem solving: (1) determine the target, (2) look for information, (3) determine the problem, (4) find the cause, (5) look for a solution, and (6) accept the solution. Glaser & Holyoak (1986) proposed a more detailed model: The problem-solver discovers the problem and then attempts to find a solution. If he cannot find one, he redefines the problem, and must redefine again and clarify the problem if the problem remains. If the solution works, he executes the plan and verifies the results. The problem is solved when the solution executes effectively, and the attempt is repeated until successful. The model proposed by Henna, Potter & Hagaman (1995) defines six steps of problem solving: (1) define the problem, (2) analyze the problem and form a hypothesis, (3) collect related data, (4) analyze, organize, and classify the data, (5) form problem solving strategies, and (6) apply the problem solving strategies. Sternberg (1996) proposed seven procedures of problem solving: (1) problem identification, (2) definition of a problem, (3) constructing a strategy for problem solving, (4) organizing information about a problem, (5) allocation of resources, (6) monitoring problem solving, and (7) evaluating problem solving.

To design an online problem solving knowledge sharing discussion activity that promotes knowledge interaction, we applied previous problem-solving studies to an online problem solving discussion context. We thus summarize the four interaction/discussion behaviors that may emerge during online problem solving knowledge sharing discussion activities: (1) propose, define, or clarify problems (propose new questions, define problems, and clarify the meaning of a question); (2) analyze the questions and give solutions (formulate strategies for solving problems, gather data from the Internet, and share them with others); (3) compare and analyze the more likely solutions (analyze, compare, and evaluate the comments posted in the forum); and (4) choose the best solution and draw a conclusion (draw a conclusion based on the analysis).

2.4 Peer-Assessment

Peer-assessment refers to the assessment conducted by a learner against his or her peers (Topping, 1998; Falchikov & Goldfinch, 2000). This kind of strategy has received more attention (Cizek, 1997; Shepard, 2000) as a method of class assessment because it involves observing others' work and asking questions, which promotes critical thinking and meta-cognitive skills (Topping, 1998; Lin, Liu, & Yuan, 2001), improves the quality of learning, and encourages learners to be active (Falchikov, 1995). Since peer-assessment requires evaluations and discussions between learners, it can be used to promote knowledge sharing.

Recently, peer assessment mechanism that utilizes the Internet technology has been widely discussed (Sung, Chang, Chiou & Hou, 2005; Lin, Liu, & Yuan, 2001). Uploading, observing, and evaluating each other's work via the internet allows faster evaluations; we wish to include the use of web technology in learner community's knowledge-interactions in order to understand the process and limitations community members face when using online peer assessment.

2.5 Online Teacher Community

Communities of organizational learning are classified as task-oriented, knowledge-oriented, and practice-oriented (Brarb, Kling, & Gray, 2004). Since the teacher community focuses more on sharing education-related experiences, it tends to be a "community of practice," and may also contain elements of professional knowledge exchange. Most teachers do not exchange their experiences (Barab et al., 2001; Tyack & Cuban, 1995), and are used to designing instructional activities in isolation (Goodlad, 1984; Rosenholtz, 1991; Tyack & Cuban, 1995). Since knowledge of teaching is often tacit (Carroll et al., 2003), it is difficult for teachers to share and exchange their knowledge of teaching. As a result, they do not effectively share their resources, hindering their teaching performance. Thus, the teacher community plays a critical role in helping teachers exchange their knowledge.

Many studies discuss the teacher community and attempt to enhance inter-teacher interactions by establishing interactive mechanisms or technological interventions (Snow-Gerono, 2005; McCotter, 2001; Olson & Craig, 2001; Hsu, 2004; Carroll, Choo, Dunlap, Isenhour et al., 2003; Stigler & Hiebert, 1999; Gibson, Neale, Carroll, & VanMetre, 1999). Due to the spatial and temporal limitations of face-to-face community interactions, more and more studies have started using online forums to create online teacher communities (Hobson & Smolin, 2001; Dana & Yendol-Silva, 2003; Sing & Khine, 2006), and some communities use online teaching films to promote knowledge sharing among teachers (Brarb, Kling, & Gray, 2004; Brarb, Barnett, Squire, 2002).

However, many studies have shown limitations in teacher interactions in community activities, including a lack of motives, interactions, and depth (Carroll, et al., 2003; Fishman & Pinkard, 2001; Barab, MaKinster, Moore, Cunningham, & The ILF Design Team, 2001; Chancy-Cullen & Duffy, 1999). Studies that explore teacher communities' online interactions are often limited to case analyses and interviews, and do not offer enough information about the limitations of interactions and the overall behavior/content pattern of teacher communities. We therefore designed online knowledge sharing discussion activities and used a larger number of samples to conduct an empirical analysis and explore potential limitations and solutions.

2.6 Online Project-based Learning

Project-based Learning (PBL) is a teaching method widely discussed and used in educational technology. Originating from scholars such as Dewey, PBL focuses on the process by which a learner defines and proposes topics, gathers and analyzes information, communicates with others, solves problems, and shares the results (Marx, Blumenfeld, Krajcik, & Soloway, 1997; Blumenfeld, et al., 1991; Blumenfeld, et al., 1994; Thomas, Mergendoller & Michaelson, 1999). PBL is a representative sample of constructive learning, and consists of: (1) inductive teaching, (2) preparing and announcing surveys and projects, (3) interactions through collaborative learning, and (4) the use of technology as a supplementary tool (Blumenfeld, et al., 1991; Blumenfeld, et al., 1994). This kind of teaching strategy is pervasively integrated with technology (Land & Greene, 2000).

Thomas (2000) pointed out that a learner in the PBL process often faces limitations when analyzing data (Krajcik, et al., 1998; Edelson, Gordon, & Pea, 1999), as learners often fail to think deeply or interact/discuss with peers and treat online resources directly as “answers” to their project (Wallace & Kupperman, 1997; Chang & McDaniel, 1995). This kind of problem may lead to inappropriate conclusions of a learning topic (Krajcik, et al., 1998), and possible causes include the learner lacking systematic data collection and meaningful compilation (Krajcik, et al., 1998). Another possible reason is the failure to interact with peers (Achilles & Hoover, 1996), as this leads to inappropriate data analysis and conclusions in a PBL setting that focuses on collaborative learning and knowledge interactions. This is closely related to the mechanism of online discussion and interaction, and many studies have shown that the mechanism of online discussion greatly affects the quality of discussions (Patricia & Dabbagh, 2005; Hewitt, 2003; Vonderwell, 2003; Swan, et al., 2000; Vrasidas & McIsaac, 1999).

A well-designed online knowledge sharing discussion activity may effectively solve the above mentioned bottlenecks. Since PBL focuses on collaborative learning and the use of technology, a PBL online community is formed when online discussion is used in the process, allowing users to gather and share relevant information and communicate with each other via online forums.

Since project-writing is a common and practical method in education settings and online PBL can be widely applied in a blended learning context, we focus on how knowledge sharing discussion activities promote online knowledge interaction, the depth of data analysis, and the discussion process of online learner communities.

2.7 Analytical Methods for Online Discussions

To explore the knowledge sharing discussions of teacher communities and PBL learner communities, we must use appropriate analytical methods. Many studies have explored interactions in online asynchronous discussions (Hewitt, 2005; Bodzin & Park, 2000; Fahy, Crawford, & Ally, 2001; Sudweeks & Simoff, 1999; Gunawardena, Lowe & Anderson, 1997; Newman, Webb & Cochrane, 1995; Levin, Kim, & Riel, 1990; Zhu, 2006); some were qualitative, in that they analyzed the original protocol of discussion content or conducted interviews or case observations, while others were quantitative content analyses or used other quantitative analysis methods. Different coding schemes were designed for analysis (Henri, 1992; Gunawardena, Lowe & Anderson, 1997). The procedures of quantitative content analysis are:

(1) Formulate coding schemes: This includes existing or newly formulated coding schemes relevant to a given research purpose. The use of existing schemes should be encouraged if they are relevant to the same research topic to ensure analytical validity; new ones should be prepared by reviewing and summarizing related studies if no appropriate ones are available (Rourke & Anderson, 2004).

(2) Conduct coding process: Categorize and code each article posted on the forum based on the coding scheme.

(3) Examine inter-rater validity: In order to ensure the validity of coded data, a part of the data is usually coded by a second coder to measure the Kappa reliability of coded data.

(4) Follow-up analysis: Conduct an appropriate quantitative analysis after data are coded to explore the characteristics of the overall discussion.

Quantitative content analysis is targeted at the frequency and ratio of different coded content, but this does not really allow us to infer behavioral patterns or determine the sequential patterns in the learner community during online knowledge sharing discussions (e.g., What kind of discussion behavior follows another behavior in the overall students' interaction process? Does the continuity of each type of discussion sequence reach a level of significance? What kind of sequential discussion behavioral patterns exist during the discussions?). This kind of sequential behavioral pattern not only helps us compare the differences between actual practice and theories, allowing us to reference prescriptive theories (e.g., problem solving or instructional-design models proposed by previous studies), but also helps us better explore the actual process, limitations, and possible causes in students' online knowledge sharing discussions (e.g., why did a learner carelessly reach a conclusion or stop the discussion?). These patterns also allow us to determine possible intervention strategies to promote further knowledge sharing; thus, behavioral patterns deserve to be analyzed and explored.

Lag sequential analysis (Bakeman & Gottman, 1997) allows us to better determine the sequential patterns in students' online discussions as it lets us accurately examine whether the sequential relationship between any two discussion behaviors is statistically significant. Some studies have already applied this method (Jeong, 2003; England, 1985; King & Roblyer, 1984; Erkens, et al., 2003). Just as in quantitative content analysis, coding schemes are required. The following five procedures of sequential analysis are then carried out (Bakeman & Gottman, 1997):

(1) Calculate the frequency transition matrix: The frequencies of transitions between codes are calculated to form a frequency matrix.

(2) Calculate the sequential transition conditional probability matrix: Based on the above matrix, we calculate the conditional probability of inter-code transitions to generate a conditional probability matrix.

(3) Calculate the expected-value matrix: Based on the above sequential frequency matrix, we calculate the expected-values of inter-code transitions to form an expected-value matrix.

(4) Calculate Adjusted Residuals Table: Based on the Z-score values yielded from the above three matrices, we examine whether the continuity of each sequence has reached the level of significance. A Z-value greater than +1.96 indicates yes

(p<0.05).

(5) Draw the behavioral transition graph: The sequences in the Z-score matrixes that are significant are extracted to make a correlation graph, in which each coded behavior is a node and the arrow represents its connection directions. The thickness of the arrow heads represents the strength of significance. Z-score values are provided for further analysis.

Since sequential analysis is more inferential in terms of analyzing knowledge-interaction behaviors, we not only used quantitative content analysis, but also used it to analyze behavioral patterns in online knowledge sharing discussions. Besides the above content and sequential analyses, we also extracted a relevant case and analyzed its original protocol of discussion content in order to provide both qualitative and quantitative analyses and allow cross-referencing.